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## PATENT SPECIFICATION

683,909



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### COMPLETE SPECIFICATION.

#### **An Improved Method of and Machine for Washing Clothes and like Articles.**

I, ROBERT CHARLES LIGHTBOURNE, a British Subject, of Long Rede, Brookhouse Road, Barnt Green, Birmingham, in the County of Warwick, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved method of, and means for washing clothes and like articles, of the kind in which the washing liquid is disposed within a container which receives the articles to be washed, and means are provided for imparting agitation to the liquid so that it flows relative to the articles to perform the desired washing action.

At present it is common practice to provide such machines with a positively driven agitator which is rotated or oscillated relative to the container so as to impart a simple circulatory motion to the liquid in the one case or to oscillate the articles bodily in relation to the liquid and container in the other case.

The present invention has for its object the provision of an improved method of, and machine for washing clothes and other articles in which the latter are washed in a particularly rapid and effective manner and in which it is believed that the wear on the clothes or other articles during the washing action is particularly small.

According to the present invention I provide a method of washing clothes and like articles which comprises circulating the washing liquid within a container for the articles and in a closed vortex which is substantially symmetrical in relation to the centre of the container and subjecting such liquid vortex to sudden changes in direction so as to obtain the requisite relative movement of the liquid in relation to the articles to be washed.

Also according to the present invention I

provide a machine for washing clothes and like articles comprising a container for receiving the articles to be washed, an impeller disposed at the bottom of the container for rotation about a substantially vertical axis which is substantially central in relation to the interior of the container, said impeller being adapted to circulate the liquid within the container in a closed vortex, a plurality of projections of elongated form on the interior of the container wall having their longitudinal axes disposed vertically or at an inclination to the vertical and spaced apart from one another circumferentially around the interior of the container, said projections projecting into the path of the circulating liquid so as to subject the liquid vortex to sudden changes in direction relative to the articles so as to obtain the required relative washing movement between the liquid and the articles to be washed.

Preferably I provide two projections only disposed on diametrically opposite sides of the container with their longitudinal axes vertical and preferably these projections are in the form of fins having their radial dimensions at a maximum adjacent their upper ends and at a minimum adjacent their lower ends, the inner edges of the fins which are directed towards the centre of the container tapering inwardly of the container between their upper and lower ends.

The closed vortex is preferably produced by means of an impeller driven through a friction clutch from a power source such as an electric motor, the engagement and disengagement of the clutch being controllable manually by the operator and the clutch comprising driving and driven members adapted to slip relatively on a given torque transmitted by the clutch being exceeded so that in the event of the clothes or other articles having become wedged against or interengaged with the impeller so as to

prevent its free rotation, damage to the articles or to the apparatus itself is avoided.

The invention is illustrated in the accompanying drawings, wherein:—

5 Figure 1 is a side elevation of a domestic washing machine for use in washing clothes and embodying the present invention.

10 Figure 2 is a part sectional plan view to an enlarged scale of the machine depicted in Figure 1.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a sectional view on the line 4—4 of Figure 3.

15 Figure 5 is a sectional view on the line 5—5 of Figure 4.

20 Figure 6 is a sectional view on the line 6—6 of Figure 3 showing to an enlarged scale part of the machine depicted in that Figure.

Referring to the drawings, the domestic washing machine for washing clothes which is there illustrated comprises a sheet metal base 10 on the upper part of which is supported a hollow cylindrical container 11 adapted to receive the clothes to be washed, the container being disposed with its axis vertical and being mounted in a stationary manner on the base.

30 The container is provided with an inwardly flanged opening 12 at its upper end and the bottom 13 of the container is formed centrally with a circular recess 14 of stepped form in cross section so that the upper part of the recess is formed with a peripheral horizontal shoulder 15 adapted freely to support the under side of the periphery of a vortex producing element. This element which is indicated at 16 is as shown most clearly in Figure 2 constructed in the form of a vaned impeller, the impeller comprising a hollow disc like shell 17 of circular form, the shell being domed on its upper side 18 and hollow on its under side and embodying a peripheral circular wall 19 and being formed further with a central boss 20.

The hollow shell-like impeller is provided internally with a number, for example five, symmetrically disposed radially extending vanes 21 having their inner and outer ends integral respectively with the boss 20 and peripheral wall 19 and having their upper edges in each case integral with the upper side of the impeller shaft.

55 The upper side 18 of the impeller shell is formed with a large number of liquid supply openings 22 conveniently arranged symmetrically in circular rows concentric with the centre of the impeller, while the peripheral wall 19 is formed with a larger number of liquid discharge openings 23 conveniently spaced symmetrically around the wall.

60 As shown most clearly in Figure 6, the impeller constructed as above described is mounted removably upon a flat circular

driving plate 24 formed with a central hole 25 which fits freely over a hollow cylindrical cap 26 which extends freely into the interior of the impeller boss 20.

The driving plate 24 is formed with a number, conveniently three upstanding projections 27 adapted each freely to engage one side of one of the impeller vanes 21 in the manner indicated in Figure 2, so that when the driving plate is rotated in the clockwise direction shown by the arrow in that Figure, corresponding rotation will be imparted to the impeller.

Rotational movement is transmitted to the driving plate 24 by providing it on its under side with a clutch face 28 so that it forms the driven element of a face to face clutch, the driving element of which is constituted by a circular driving disc 29 provided with a clutch face 30 on its upper side, the driving disc being formed integrally with the hollow cap 26 aforementioned, which hollow cap is in turn mounted rigidly on the upper end of a vertical driving shaft 31, the axis of which is aligned with the centre of the impeller and the central axis of the cylindrical container 11 so that the impeller is rotated about a vertical axis aligned with the central vertical axis of the cylindrical container 11.

This driving shaft 31 is mounted for vertical sliding movement relative to the machine base 10 and container 11, the upper part 32 of the shaft extending slidably through a liquid tight gland 33 provided adjacent a central opening 34 in the bottom of the recess 14, the gland being in fact mounted within one end of a sleeve like member 35 which extends through the opening 34. The shaft 31 is guided during its vertical sliding movement by providing it with a bearing 36, the outer member of which is housed within a collar 37 vertically slidable within the sleeve like member 35.

The lower end of the shaft 31 is provided with a thrust bearing 38 supported from a short non-rotatable shaft 39 aligned with the rotatable driving shaft 31, this short shaft being vertically slidable within a tubular part 40 supported rigidly from the machine base, the tubular part being formed with a pair of diametrically opposed vertically extending slots 41 in which work opposite ends of a pin 42 which passes diametrically through the shaft 39, the ends of the pin as shown in Figure 3 being connected to the two arms of a forked member 43 pivoted intermediate its ends 44 to the machine base, the opposite end of the forked member being provided with a pin 45 parallel to the pin 42 and working within a slot 45 in one end of an operating lever 47 pivoted intermediate its ends at 48 to the machine base, the opposite end of the lever being provided with an oper-

ating handle 49. The arrangement is such that when the operating handle is displaced into the raised position shown in Figure 3, the forked member 43 is pivoted in an anti-clockwise direction in that Figure to raise the driving shaft 31 so as to engage the driving and driven clutch elements, while when the operating handle is displaced into the inoperative position indicated in dotted outline in Figure 3, the driving shaft 31 is lowered so as to disengage the two clutch elements.

The operating handle projects through a vertical slot 50 in the machine base as shown in Figure 1, the opposite ends of the slot being enlarged as shown at 51 so that the handle at its two extreme positions can be displaced slightly laterally to retain it positively in either position.

As will be apparent from Figures 3 and 6, the effect of raising the driving shaft 31 is to raise the driving disc 29 so as to bring its clutch face 30 into operative engagement with the clutch face on the driving plate 24 and the vertical movement of the driving shaft is such that when the shaft is in its lower inoperative position it permits of the clutch face 28 of the driving plate 24 resting on the shoulder 15 of the container recess 14. Thus when the driving shaft is lowered to its inoperative position, not only is the clutch disengaged to disconnect the drive but the impeller 16 is brought immediately to rest so that in the event of any clothes having become caught up on the impeller further movement of this can immediately be arrested, while when the driving shaft is raised into its operative position shown in Figures 3 and 6 of the drawings, the driving plate 24 upon which the impeller is mounted is brought completely clear of the shoulder 15 so that it can now rotate freely under the torque imparted to it from the shaft 31.

The driving shaft 31 is driven from an electric motor 52 through a belt drive 53 and pulley 54 on the shaft 31, the provision of the belt drive permitting of the shaft 31 and pulley 54 moving vertically freely relative to the motor and its associated driving spindle.

A further belt drive 55 is taken from the motor to a small water pump 56 which serves to empty the container 11 at the conclusion of the washing operation, the pump 56 being driven continuously by the motor, and being connected through the pipe 57 as shown in Figure 5, to the bottom of the container 11. The pipe 57 is normally closed by a discharge valve 58 provided with an operating knob 59, which valve is opened when discharge of the washing liquid is required, the liquid being fed by the pump to an outlet pipe 60.

The vertical wall of the cylindrical container 11 is provided internally, as shown

in Figures 2 and 3, with a number of projections which as shown are constructed in the forms of fins depicted at 61 and preferably two such fins only are provided at diametrically opposite sides of the container as is clearly shown in Figure 2, which fins are either disposed in a vertical position as shown, or at an inclination to the vertical.

These fins 61 serve to impart a radial component to the circulatory movement of the washing liquid which is obtained when the impeller 16 is rotated at high velocity from the electric motor 52.

When the impeller 16 is rotated in this way the washing liquid is circulated around the interior of the container in the form of a closed vortex of the general form depicted in dotted outline at 62 in Figure 3 and the fins as described hereinafter serve to subject this vortex continuously to sudden changes of direction.

Preferably the fins as shown are of substantially triangular form in cross section but present a bulbous inner edge 63 to the washing liquid, that is to say, the inner edge is free from any sharp projections against which the clothes or like articles might catch and thereby become damaged.

I find that most satisfactory results are obtained by disposing the fins so that they extend for the greater part of the entire depth of the container, the fins projecting above the level of the washing liquid within the container as is clearly shown in Figure 3 and being of tapered configuration so that their radial dimension is at a maximum at their upper ends, this dimension decreasing uniformly in a downward direction to the lower end of the fins.

In operation the clothes to be washed are placed within the container 11 so that they rest largely on the upper side of the impeller 16 which is in fact adapted to support the articles to be washed, the container is then partially filled with the washing liquid, current is supplied to the motor and the operating handle 49 raised so as to raise the driving shaft 31 and engage the driving and driven clutch elements bringing the impeller 16 out of contact with the shoulder 15 so that the impeller is now rotated continuously in the one direction at high velocity.

By reason of the provision of the impeller vanes 21 a substantial momentum is imparted to the liquid immediately adjacent to and in advance of each vane in its direction of rotation, the liquid being discharged centrifugally outwardly to the impeller discharge openings 23 and flowing into the interior of the impeller through the supply openings 22 and at the same time, a rotational movement is imparted by the impeller to the liquid in the washing compartment so that this is circulated within the interior of

the container as a closed vortex as shown at 62.

Since the impeller is mounted for rotation about an axis which is aligned with the central vertical axis of the container the closed vortex will itself be substantially symmetrical in relation to the centre of the container as is clearly shown in Figure 3.

Without the provision of the fins 61 this vortex would be of simple hollow circular form at all points but as a result of the provision of the fins, the vortex is subjected continuously to sudden changes of direction, the fins in fact, imparting an inward component to the movement of the liquid towards the centre of the container and it is by these sudden changes in direction of the washing liquid that the washing action is effected.

Although when the impeller 16 is rotated at high velocity to produce the vortex 62, the clothes tend to circulate with the liquid, it will be found that the sudden changes of direction which are imparted to the liquid by the fins are not imparted to the clothes to anything like the same extent so that substantial relative and rapid movement occurs between the liquid and the clothes so that these are washed in a particularly effective manner.

A convenient speed of rotation of the impeller is approximately 600 revolutions per minute.

With the present invention the washing action is performed entirely by the relative movement obtained in the above way between the washing liquid and the clothes. There are no rotating or oscillating blades, or paddles, the blades or paddles of which are exposed directly to the clothes as is at present customary in washing machines of the above kind, and which may be liable in practice to producing appreciable wear of the clothes and as will be observed, the impeller vanes 21 are shielded from direct contact with the clothes so that they cannot possibly cause these to wear in any way and in fact, it is believed that a washing machine in accordance with the present invention subjects the clothes to substantially less wear than is the case with existing machines of the above kind.

The vortex produced in the washing liquid within the container results in the known manner in a downward pressure component being produced by the liquid at the base of the centre of the vortex, which pressure component increases with increase in circulatory velocity of the vortex and applies a downward pressure to the impeller 16 forcing the driven clutch face 28 into increasingly tight engagement with the driving clutch face 30, thus enabling quite a substantial torque to be transmitted to the impeller without slip occurring between the

impeller and the driving shaft. Although there is little likelihood with the machine described of the clothes becoming entangled in the impeller, in the event of this happening, so as to apply a retarding force to the impeller, the friction clutch permits of immediate slip of the impeller relative to the driving shaft whereupon the circulatory velocity of the liquid vortex is immediately reduced with consequent reduction in the aforesaid downward pressure component so that further slip between the impeller and driving shaft is facilitated and the impeller very rapidly brought to rest with little likelihood of the clothes which have caught up on the impeller in this way being damaged.

Further, if the machine were grossly overloaded with clothes, on switching on the motor the rotating torque exerted by the clothes on the impeller would be so great as to permit of immediate slip of the clutch when this is engaged so that running of the machine under overloaded conditions would be prevented.

When the washing action is completed, the operating handle 49 is returned to its initial inoperative position so as to disengage the clutch and permit of the impeller returning gravitationally into engagement with the shoulder 15 after which the valve 58 may be opened to permit of drainage of the washing liquid from the container through the medium of the pump 56.

In addition to possessing the safety characteristics above referred to, the provision of a frictional slippable coupling between the impeller and the power-operated driving shaft enables the impeller to be safely accelerated from rest with the use of a simple electric motor of constant speed characteristics without the necessity for the drive to include a gear box, so that a relatively inexpensive form of drive for the impeller may safely be adopted.

The impeller which is described in the present Specification is found to impart velocity to the liquid so as to form the vortex in a particularly efficient manner so that the machine can be driven with the consumption of very little power with the result that its manufacture and operating costs are particularly low and it is especially suitable for domestic washing purposes.

In my Specification No. 8121/50 (Serial No. 683,910) I have described and claimed a machine for washing clothes and like articles of the kind comprising a container element for the washing liquid, a liquid agitator element and means for imparting rotation to one of said elements so as to cause the same to rotate relative to the other to perform the desired washing action, said machine being characterized in that the means for imparting rotation to one of the said elements embodies a friction clutch

through which the drive is transmitted from a power source such as an electric motor, the engagement and disengagement of the clutch being controllable manually by the operator.

What I claim is:—

1. A method of washing clothes and like articles which comprises circulating the washing liquid within a container for the articles and in a closed vortex which is substantially symmetrical in relation to the centre of the container and subjecting such liquid vortex to sudden changes in direction so as to obtain the requisite relative movement of the liquid in relation to the articles to be washed.

2. A machine for washing clothes and like articles comprising a container for receiving the articles to be washed, an impeller disposed at the bottom of the container for rotation about a substantially vertical axis which is substantially central in relation to the interior of the container, said impeller being adapted to circulate the liquid within the container in a closed vortex, a plurality of projections of elongated form on the interior of the container wall having their longitudinal axes disposed vertically or at an inclination to the vertical and spaced apart from one another circumferentially around the interior of the container, said projections projecting into the path of the circulating washing liquid so as to subject the liquid vortex to sudden changes in direction relative to the articles so as to obtain the required relative washing movement between the liquid and the articles to be washed.

3. A machine according to Claim 2 further characterized in that the projections extend for substantially the full vertical depth of the washing liquid within the container.

4. A machine according to Claim 2 or 3 wherein the container is of cylindrical form internally with its central axis vertical and two projections only are provided in the form of fins disposed on diametrically opposite sides of the container.

5. A machine according to Claim 4 wherein the fins project radially inwardly towards the vertical central axis of the container, the radial dimensions of the fins being at a maximum adjacent their upper ends and at a minimum adjacent their lower ends, the radial inner edges of the fins tapering towards the central axis of the container in a direction from the lower to the upper ends of the fins.

6. A machine according to any of Claims 2 to 5 further characterized in that the impeller is provided with a plurality of circumferentially spaced peripheral liquid discharge openings adapted to impart the desired closed vortex circulation to the

washing liquid when the impeller is rotated at the requisite rotational velocity.

7. A machine according to Claim 6 wherein the impeller is of hollow form and provided with liquid supply openings disposed between the periphery of the impeller and the axis of rotation thereof, the liquid being adapted to flow through said supply openings into the interior of the impeller and to be discharged therefrom through said discharge openings.

8. A machine according to Claim 7 further characterised in that the impeller embodies one or more vanes and means are provided for shielding the vanes from direct contact with the clothes or other articles to be washed.

9. A machine according to Claim 7 further characterised in that the impeller is in the form of a hollow disc like shell of circular form and embodying a peripheral wall provided with a plurality of radially extending circumferentially spaced liquid discharge openings, the upper side of the hollow impeller shell being formed with a plurality of liquid supply openings, the shell being provided internally with a number of vanes constructed as plain flat webs disposed in a vertical plane and extending radially out from the central boss at the axis of rotation of the impeller.

10. A machine according to any of Claims 2 to 9, further characterised in that the impeller is adapted to support the articles to be washed and is adapted to be driven through the medium of a face to face friction clutch adapted to slip on a given torque being exceeded, the arrangement being such that the downward pressure in the vortex produced within the container is transmitted through the impeller to the clutch so as to increase the pressure between the clutch faces, while in the event of any article becoming caught up on the impeller so as to restrain its rotation, slip occurs at the clutch with a consequent collapse or partial collapse of the vortex accompanied by corresponding reduction in the pressure between the clutch faces.

11. A machine according to any of Claims 2 to 8, further characterised in the provision of means for transmitting the drive to the impeller from a power source such as an electric motor through a frictional clutch, the engagement and disengagement of the clutch being controllable manually by the operator and the clutch comprising driving and driven members adapted to slip relatively on a given torque transmitted by the clutch being exceeded.

12. A machine according to Claims 9 or 10 further characterised in that the impeller is disposed at the bottom of the container so as normally to be supported therefrom in a stationary manner but

capable of being raised out of engagement with the base by a vertical movement, the machine being provided with a vertical displaceable driving shaft, the upper end of the shaft carrying a driving friction clutch element adapted for frictional engagement with a driven clutch element operably connected to the impeller, the arrangement being such that the drive is transmitted to the impeller by raising the shaft manually so as to engage the clutch and lift the impeller out of engagement with the bottom of the container, the impeller being adapted gravitationally to re-engage with the bottom

of the container so as to bring it rapidly to rest when the shaft is lowered and disengagement of the clutch effected. 15

13. A machine for washing clothes substantially as hereinbefore described with reference to and as shown in the accompanying drawings. 20

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# PROVISIONAL SPECIFICATION.

No. 8078, A.D. 1950.

## An Improved Method of, and Machine for Washing Clothes and like Articles.

I, ROBERT CHARLES LIGHTBOURNE, a British Subject, of Long Rede, Brookhouse Road, Barnt Green, Birmingham, in the County of Warwick, do hereby declare this invention to be described in the following statement:—

This invention relates to an improved method of, and means for washing clothes and other articles, of the kind in which the washing liquid is disposed within a container which receives the articles to be washed, and means are provided for imparting agitation to the liquid so that it flows relative to the articles to perform the desired washing action.

At present it is common practice to provide such machines with a positively driven agitator which is rotated or oscillated relative to the container so as to impart a simple circulatory motion to the liquid in the one case or to oscillate the articles bodily in relation to the liquid and container in the other case.

The present invention has for its object the provision of an improved method of, and machine for washing clothes and other articles in which the latter are washed in a particularly rapid and effective manner and in which it is believed that the wear on the clothes or other articles during the washing action is particularly small.

According to the present invention I provide a method of washing clothes and other articles which comprises circulating the washing liquid within the container for the articles in a closed vortex and subjecting the liquid vortex to sudden changes in direction so as to obtain the requisite relative movement of the liquid in relation to the articles to be washed.

Also according to the present invention I provide a machine for washing clothes and

other articles, comprising means for circulating the washing liquid within the container in a closed vortex, and means for subjecting the liquid vortex to sudden changes in direction relative to the articles so as to obtain the requisite relative movement of the liquid in relation to the articles to be washed.

In a more specific form my machine comprises a container of substantially cylindrical form with its central axis vertical, a combined article-supporting and vortex-producing element disposed at the base of the container and capable of rotation in relation thereto about an axis coincident with, or parallel to the central axis of the container, means for imparting a rotary motion to said article-supporting and vortex-producing element, a plurality of fins on the interior of the cylindrical container wall disposed vertically or at an inclination to the vertical and spaced circumferentially around the interior of the container, said fins being adapted suddenly to change the direction of the vortex locally so as to impart a radial component to its motion and cause the liquid to have the requisite relative movement in relation to the articles to be washed.

Preferably two fins would be provided extending vertically and disposed on diametrically opposite sides of the cylindrical container.

The support and vortex-producing element may be non-positively connected to the rotation-imparting means, and the connection is preferably a face to face frictional coupling with the element free to move vertically in relation to the rotation-imparting means, and the arrangement may be such that as an increased torque is transmitted through the face to face frictional



coupling in consequence of an increase in load provided by the articles to be washed, the downward pressure component which obtains along the axis of any rotation of any vortex causes an increase in the downward frictional component between the two faces of the face to face frictional coupling which enables the increased torque to be transmitted to the articles without slip, while in the event of the articles being positively held against rotation as by being jammed within the container in any way, slip can occur at the coupling which results in rotational velocity of the liquid vortex being suddenly reduced with corresponding reduction in the downward component produced by the vortex at the friction coupling, so that further slip occurs at the coupling and the article-supporting and vortex-producing element rapidly decelerates until the positive holding of the articles against rotation has been rectified.

The arrangement therefore reduces the possibility of damage to the clothes or other articles within the container in consequence of these becoming jammed therein for any reason, for example, through over-loading of the container with articles.

In a preferred arrangement the combined article-supporting and vortex-producing element would be non-positively driven in the specific manner described in my Provisional Specification No. 8121/50 (Serial No. 683,910) of even date, and at a speed of, for example, 600 r.p.m.

In one particular construction as applied to a domestic washing machine for washing clothes, a machine in accordance with the present invention comprises a container of cylindrical form having an open inwardly flanged mouth at its upper end, the container being mounted in any convenient stationary manner with its central axis vertical, and having its base dished centrally downwardly to provide a circular recess of stepped form in cross section so that the recess approximately centrally of its depth has a peripheral shoulder upon which is adapted to rest the underside of the periphery of a combined clothes-supporting and vortex-producing element.

This element is conveniently constructed in the form of a circular disc provided on its upper face with a paddle so shaped as to produce a vortex in the washing liquid within the container when the said element is rotated at high velocity about the central axis of the container, the vortex being of the known circular form having the usual central space of substantially inverted conical configuration.

The clothes-supporting and vortex-producing element is free to be displaced vertically within the recess above the shoulder, and is adapted on its underside to

have face to face frictional engagement with the upper face of a cylindrical turn-table disc, which disc is carried upon the upper end of a vertical shaft aligned with the central axis of the container, the shaft being vertically slidable through a water-tight seal provided at the bottom of the recessed part of the container base, and the shaft below such seal being guided for vertical movement by an anti-friction bearing, the inner race of which is carried by the shaft, the outer race being housed within a sleeve which engages, so as to be vertically slidable thereon, with the interior of a bush which depends from the underside of the bottom of the recess.

The shaft below such bearing may have mounted thereon a relatively wide belt pulley of cylindrical form which may be belt-driven from a cylindrical or "V" pulley connected to a constant speed electric motor which constitutes the necessary power unit, and the belt drive connection permits of the shaft being displaced vertically relative to the motor during the actual transmission of the drive.

The lower end of the shaft is supported rotatably by a thrust bearing, from the stationary part of which depends a tubular portion having a diametrically extending slot in which works one end of a lever which may engage with a further part of the stationary portion of the thrust bearing, the lever being pivoted intermediate its ends so that by depressing the outer or free end of the lever, the shaft is displaced vertically from an inoperative position in which its turn-table disc is out of contact with the vortex-producing element to an operative position in which the turn-table disc engages frictionally with said element to impart rotation thereto through the slippable frictional clutch provided by the inter-engageable faces of the two parts.

Suitable means may be provided for locking the lever in its two positions.

The container is provided on the interior of its wall conveniently at two diametrically opposed positions with radially inwardly projecting fins which extend vertically, the fins having their maximum radial dimension at their upper ends and tapering along their inner edge downwardly towards their lower extremity where the inner edge is adjacent the container wall so that the fins are of triangular form in configuration.

In operation the clothes to be washed would be placed within the container so as to rest on the combined clothes-supporting and vortex-producing element, the container would be partially filled with the washing liquid, the motor would be started, and the lever depressed so as to raise the shaft and bring the turn-table disc thereof into driving frictional engagement with the underside of

the vortex-producing element, so as to rotate this at high velocity, the element being lifted clear of the shoulder of the recess upon which it inoperatively rests as the lever is displaced to the full operative position.

The paddle provided on the upper side of the vortex-producing element serves in consequence of the rotation of the element at high velocity both to impart rotation to the clothes and also, and more importantly, to circulate the liquid within the container in the form of a circular vortex having the usual central depression of inverted conical configuration.

However, true vortical motion of simple circular form on the part of the liquid is immediately inhibited by the fins on the inner side of the container wall which continuously break up the vortex formed by the vortex-producing element, and in fact subject the circular vortex of washing liquid within the stationary container to continued sudden changes in direction so that the circulation of the liquid in plan is somewhat in the form of a figure 8.

Thus a marked radial component is imparted to the liquid which is thus caused rapidly to traverse the clothes and exert a strong washing action thereon with the result that these are washed in a particularly rapid and effective manner, the clothes during the actual washing action being in a state of suspension within the liquid so that they are not subjected substantially to the wear of any moving rigid parts as is customary in washing machines of the above kind which are provided with rotating or oscillating agitators which serve continuously to engage with the clothes.

Thus, as compared with such machines, a machine in accordance with the present invention can be expected to subject the clothes to substantially less wear during washing.

The vortex produced in the washing liquid results in the known manner in a downward pressure component being produced by the liquid at the base of the centre of the vortex, which pressure component increases with increase in vortex velocity so as to apply downward pressure to the vortex-producing element and force it into tighter frictional engagement with the upper face of the turn-table disc as the vortex velocity increases, thereby enabling the requisite increased torque to be transmitted to such element as the speed of movement of the liquid within the container rises when the element has reached full velocity and initial slip on initial engagement of the turn-table disc therewith with the at-first-stationary element has been overcome.

Normally with a machine as above described, there is no danger of the clothes becoming damaged in any way within the

machine in consequence of them becoming wrapped around a positively driven rotatable or oscillatable paddle or agitator; but if the machine was grossly over-loaded with clothes so that these pressed down tightly on the vortex-producing element during the actual washing action, the downward pressure would impart a substantial retarding torque to the element, causing slip to occur between the two inter-engageable clutch faces provided by the underside of the element and the upper side of the turn-table disc.

As soon as this slip took place, the rotational velocity of the element would decrease with consequent decrease in the in the downward component of the pressure produced by the vortex on the upper side of the element so as to decrease the frictional pressure above referred to between the two faces of the frictional coupling, thus permitting of further slip taking place and of the element rapidly decelerating, if necessary to rest until any jamming of the clothes consequent on the gross over-loading of the container has been removed.

Thereupon the inherent friction within the friction coupling is sufficient to cause the vortex-producing element again to rotate in unison with the turn-table disc without slip therebetween so that the washing action is again resumed in the manner already described.

On the washing action being completed, the lever would be displaced back to its inoperative position so as to lower the vortex-producing element until its periphery again rests on the shoulder of the recess in the container base, the lever as it moves further to its inoperative position effecting complete disengagement of the turn-table disc from the underside of the element, so that the latter is now brought to rest, whereupon the motor may be switched off and the washing liquid drained out of the container.

In addition to possessing the safety characteristics above referred to, the provision of a frictional skippable coupling between the vortex-producing element and the the power-operated driving shaft enables the element to be safely accelerated from rest with the use of a simple electric motor of constant speed characteristics without the necessity for the drive to include a gear box.

so that a relatively inexpensive form of drive for the element may safely be adopted. The inter-engaging faces of the turn-table disc and element may be covered with rubber or other suitable clutch facing material adapted to permit of a certain initial slip occurring while enabling the requisite torque to be transmitted when the element has attained its maximum speed.

If desired, however, the shaft may be driven from the motor through a gear box



instead of through a belt drive, or in fact the shaft may be connected directly to the motor, in which event it would be necessary to displace the motor vertically with the shaft when the lever is moved into its operative position.

The various parts of the machine which come into contact with the clothes may be suitably covered with rubber or a plastic if desired.

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# PROVISIONAL SPECIFICATION.

No. 28618, A.D. 1950.

## An Improved Method of, and Machine for Washing Clothes and like Articles.

I, ROBERT CHARLES LIGHTBOURNE, a British Subject, of Long Rede, Brookhouse Road, Barnt Green, Birmingham, in the County of Warwick, do hereby declare this invention to be described in the following statement:—

This invention relates to an improved method of, and means for washing clothes and other articles, of the kind in which the washing liquid is disposed within a container which receives the articles to be washed, and means are provided for imparting agitation to the liquid so that it flows relative to the articles to perform the desired washing action.

One particular method and means for washing clothes and other articles of the foregoing kind is the subject of my prior Patent Application No. 8078/50 in which I have described the circulation of the clothes washing liquid in a closed vortex within a container for the liquid and clothes or other articles to be washed and in which I have described the closed vortex as being produced by the rotation of a paddle which is disposed at the base of the container and which serves when rotated to produce the closed vortex therein.

Such a paddle serves to produce the vortex by a simple rotary movement so as to impart a substantially circular motion to the adjacent mass of liquid and the present invention has for its object an improved method and means for producing the closed vortex referred to.

According to the present invention I produce the closed vortex by means of an impeller which is adapted to be rotated about a substantially vertical axis, the impeller being of hollow form provided with liquid supply and discharge openings so arranged that the liquid is adapted to flow into the impeller at a position between its axis of rotation and its periphery and to be discharged centrifugally therefrom adjacent the periphery of the impeller so that the

desired closed vortex circulation is imparted to the liquid.

Preferably the impeller embodies one or more vanes and means are provided for shielding the vanes from direct contact with the clothes or other articles to be washed.

For example, the impeller may be in the form of a hollow disc like shell preferably of circular form and embodying a peripheral wall provided with a large number of radially extending circumferentially spaced liquid discharge openings, the upper side of the hollow impeller shell being formed with a large number of liquid supply openings, the shell being provided internally with a number of vanes conveniently constructed as plain flat webs disposed in a vertical plane and extending radially out from the central boss at the axis of rotation of the impeller.

In one particular construction as applied to a domestic washing machine for washing clothes, the machine may, in general, be constructed as described in my aforesaid Specification No. 8078/50, but in accordance with the present invention the vortex producing element instead of being in the form of a blade exposed to the clothes within the container comprises a hollow impeller of substantially disc like form, the impeller being preferably formed as a hollow die cast disc like shell open on its under side and having its upper side of slightly domed configuration and provided on its periphery with an integral dependent circular flange which merges into the upper side of the shell along a bevelled or radiused edge.

The upper side of the impeller shell is provided near its centre with a dependent hollow cylindrical boss from the periphery of which radiate a number, for example, five symmetrically disposed vanes having their inner ends integral with the boss and having their out ends integral with the peripheral flange of the impeller and their upper edge

integral with the under side of the impeller shell, the lower edge of each of the vanes together with the lower edge of the boss and peripheral flange being all disposed in a common symmetrical plane.

Each of the vanes aforesaid are radial with respect to the central axis of the impeller.

The upper side of the impeller shell is formed with a very large number of liquid supply openings conveniently round holes which are arranged symmetrically in a number of concentric rows having their centres coincident with the central axis of the impeller shell, and the holes in each row as well as the rows themselves being spaced closely together with the rows disposed between the periphery of the boss and the peripheral flange.

The peripheral flange is formed with a number of liquid discharge openings conveniently in the form of slots or round holes, a single row of which may be provided extending completely around the peripheral flange with their major axes extending circumferentially, the opposite ends of the slots being of semi-circular form and the ends of adjacent slots being spaced closely apart.

The impeller constructed as above described is mounted detachably in a horizontal position with its central axis vertical upon a driving plate conveniently in the form of a flat disc of circular form supported in a horizontal position symmetrically at the base of the container, the plate being provided on its under side with a clutch facing so that it forms the driven element of a face to face friction clutch, the driving element of which is constituted by a second generally similar disc mounted upon the upper end of a vertical driving shaft and provided on its upper face with a layer of clutch facing material.

The vertical driving shaft is vertically slidable relative to the container in the manner described in my Specification aforesaid, the arrangement being such that when the shaft is lowered the driving element being such that when the shaft is lowered the driving element of the clutch is disengaged from the driven element, the periphery of which is supported by a shouldered part of the container base while on raising the shaft the clutch elements are engaged and the driven element lifted clear of the container base so as to be rotated at high velocity.

The driving element of the clutch is provided centrally with an upstanding spigot which projects freely through a central opening in the driven element and into the interior of the boss of the impeller so as loosely to centralise the impeller in relation to the driven element of the clutch, while

the latter is provided on its upper side with impeller driving projections conveniently of rectangular form in cross section having their major axes substantially radial. Four such projections may be provided in all, two being disposed in closely spaced parallel relationship at one side of the driven element near the periphery adapted to engage closely with opposite sides of one of the impeller vanes while two further such projections may be provided at the opposite side of the driven clutch element spaced apart by a distance corresponding substantially to the spacing of adjacent vanes, one projection being adapted to engage on one side of one vane and the other projection being adapted to engage with the other side of an adjacent vane.

The driven element may be provided on its upper side at positions spaced circumferentially from the vanes of the impeller when in a position with a number of stiffening ribs and the whole element would preferably be formed as a die casting.

The clutch facing material on the under side of the driven element may be extended around the periphery of the metal disc forming such element and continued for a short distance inwardly on the upper side thereof to provide an annular peripheral seating on which the lower edge of the peripheral impeller flange can rest, the arrangement being such that the impeller can readily be removed from its operative position for cleaning purposes and replaced.

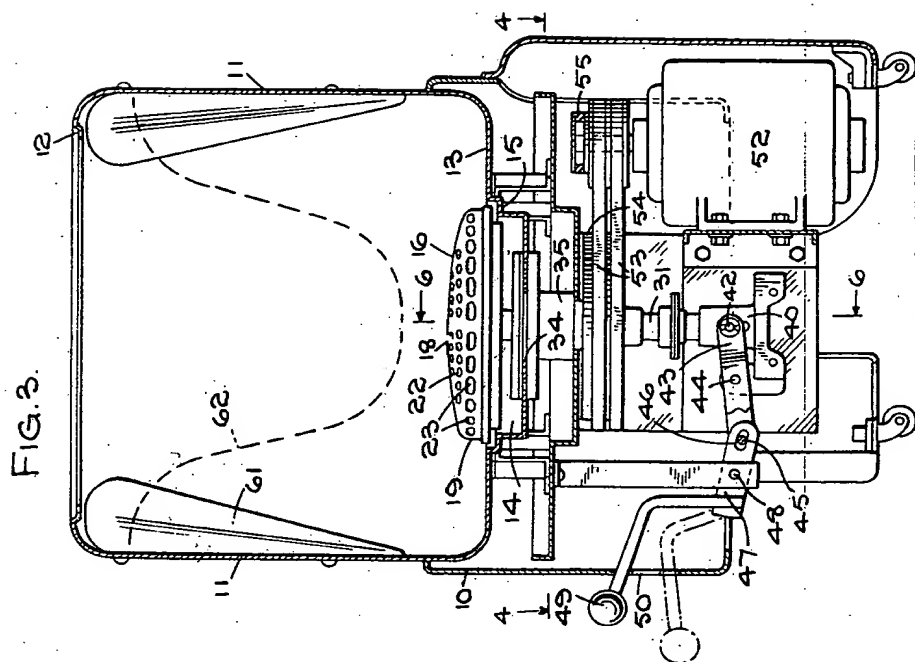
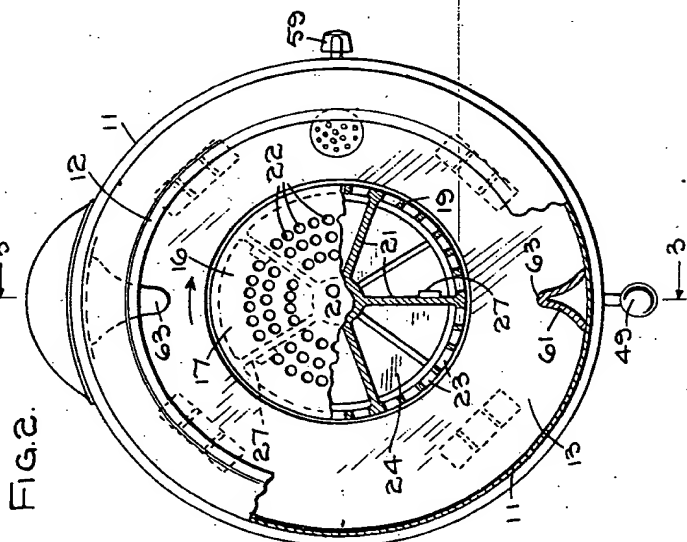
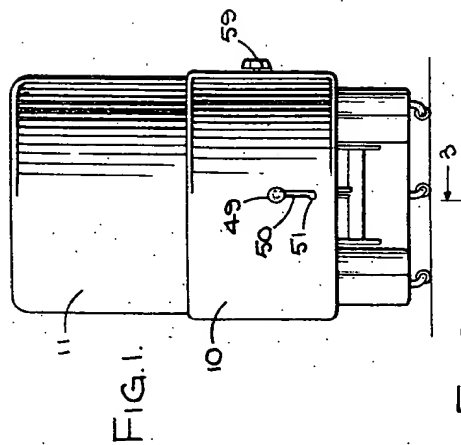
The operation of such a washing machine is general similar to that of the washing machine described in my foregoing Specification but the impeller which forms the subject of the present invention is particularly effective in promoting the circulation of the washing liquid, as the liquid enters the impeller through the liquid supply openings in a substantially axial direction at a position intermediate the axis of rotation of the impeller and the periphery thereof, the liquid entering the sector like compartments formed by the hollow interior of the impeller shell, the impeller vanes and the upper side of the clutch element upon which the impeller is supported. In each of these compartments the liquid by reason of the high rotational velocity of the impeller is subjected to centrifugal force by which it is impelled in an outward horizontal direction through the liquid discharge openings at the periphery of the impeller, appreciable momentum being impelled to the liquid in this way so that the whole mass of liquid is rotated at high velocity about the central vertical axis of the container to form a closed vortex which is subjected to sudden changes in direction in the manner described in the foregoing Specification.

The impeller which is described in the

- present Specification is found to impart velocity to the liquid so as to form the vortex in a particularly efficient manner so that the machine can be driven with the consumption of very little power with the result that its manufacture and operating costs are particularly low and it is especially suitable for domestic washing purposes.
- Furthermore, the vanes are disposed within the interior of the impeller, the peripheral and upper surface thereof which is presented to the articles to be washed is smooth, and free from all projections so that there is nothing on the impeller upon which articles can catch so that damage to the articles by contact with the impeller when this is driven at high velocity and at a speed, for example, of 600 r.p.m. is eliminated.
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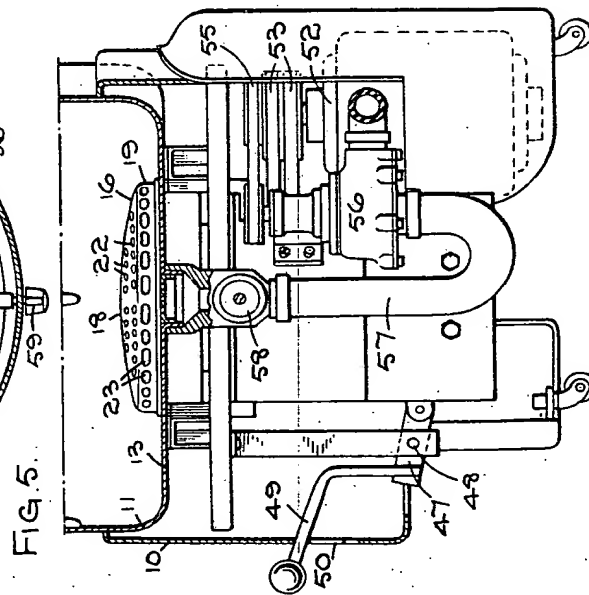
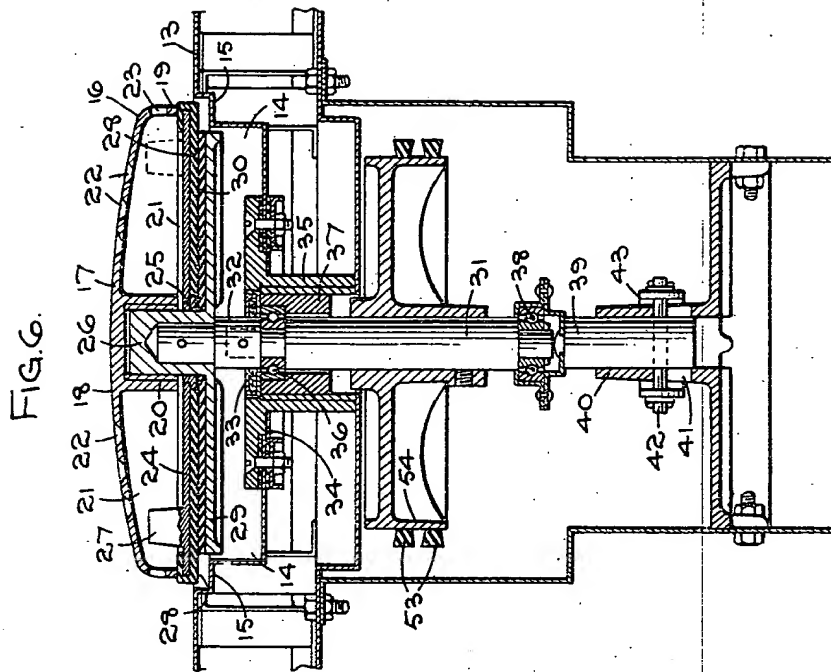
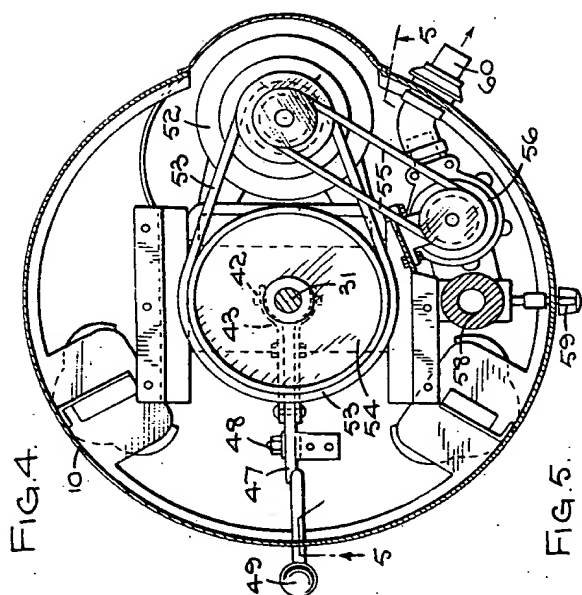
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